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In developing countries, does the implementation of basic cardio-pulmonary resuscitation education in the community improve patient outcomes?

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In developing countries, does the implementation of basic cardio-pulmonary resuscitation education in the community improve patient outcomes?

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Introduction

Ischemic heart disease is the number one cause of harm and death in Nicaragua.[1] Without proper care, this can result in cardiac arrest. Even though cardio-pulmonary resuscitation (CPR) cannot fix a blockage in the heart, it can continue to circulate blood throughout the body until definitive care can be reached. Definitive care can be recognized as defibrillation to correct the ineffective electrical conduction of the heart or reversal of a blockage causing ineffective perfusion of the heart. Therefore, there must be medications, a defibrillator or a cardiac catheterization lab at a clinic or hospital for effective CPR to have a positive outcome on cardiac arrest patient discharge rates from the hospital. Survival for those suffering out-of-hospital cardiac arrest (OHCA) is a global issue, and we have seen that high-quality CPR can positively impact patient outcomes.[2] However, when performed incorrectly or late, which could be due to location of arrest or lack of bystander education, prognosis worsens.[3]

Circulatory shock and cardiovascular diseases contribute to significant mortality globally, with an increased burden in developing countries.[4] Both the American Heart Association (AHA) and the International Liaison Committee on Resuscitation (ILCOR) support the impact proper CPR can have on OHCA, and stress the importance of maintaining the skills of health care professionals, but also educating the public in Basic Life Support (BLS) techniques. The purpose of all high-quality CPR is return of spontaneous circulation (ROSC), which for these purposes will be defined as a palpable central arterial (carotid or femoral) pulse without ongoing CPR.[5]

Low-income, third world countries lack the well-established pre-hospital resources we have in the United States. Emergency Medical Services in third world countries consist of, at most, a vehicle, stretcher, and emergency lights and siren; however, most patients arrive by foot or personal transportation.[6] In third world countries, the implementation of Basic Life Support

(BLS) education to the community and health care professionals will have a positive impact on cardiac arrest patient outcomes.

Background

CPR compliant guidelines

Cheskes et al found that for short-term CPR, where ROSC was obtained within 10 minutes of cardiac arrest, there were no differences in the patient survival when comparing the guideline compliant and non-compliant groups.[2] However, if guideline compliant CPR was performed for greater than 10 minutes before ROSC, the patient's likelihood of survival increased significantly when compared with non-guideline compliant CPR (OR 2.17; 95% CI: 1.11, 4.27).[2] This is an important finding because of the increased response time, limited resources and extended transport times experienced in third world countries.

The study performed by Wik et al, found there to be a correlation between high-quality bystander CPR and patient discharge rates from the hospital.[7] They defined good CPR as a palpable pulse during compressions and chest wall movement with ventilation.[7] A key component of the improved discharge rate is that the time interval between when a patient becomes unconscious and pulseless to the point when CPR is initiated, is decreased when bystanders are educated in CPR. In many situations, especially in third world countries where adequate EMS resources and personnel are lacking, there are extended response times and transport times. Therefore, bystander knowledge of CPR is even more critical to perfuse the patient's vital organs in cardiac arrest until EMS arrives or definitive care in a hospital or clinic is reached. In patients having a witnessed OHCA, patient discharge rates were increased if the patient received good bystander CPR (19%) when compared to the group who received inadequate CPR (2%) or did not receive any bystander CPR (4%).[7] They found good CPR when

compared with inadequate or no CPR, to improve patient outcomes and discharge rates by 23-fold.[7] This supports the positive impact bystander CPR education can have on patient outcomes in out-of-hospital cardiac arrest.

A novel study performed by John et al, used a computer model to simulate and evaluate the effectiveness of CPR within the AHA and European Resuscitation Council (ERC) guidelines. They provided evidence through computer simulation that high-quality CPR will increase patient's chance of survival after cardiac arrest. There is more to compressions and CPR than just pushing hard and pushing fast, a common phrase used in the past when teaching AHA guidelines. The study found the most effective compressions to be between 100-120 compressions per minute, with a significant decrease in cardiac output at rates higher than this, and the most effective compression depth between 5 to 5.7cm.[8] The theory behind this is that with faster compressions and higher compression pressures, or an increased compression depth, the heart is unable to fully fill on chest recoil and flow can become obstructed with vessel collapse.

Educational Impacts:

Evidence shows beneficial patient outcomes, regardless of age, when the public is educated on basic resuscitation skills. Some studies, such as Bookman et al, show skills and techniques learned are retained long-term (9 and 12 months post-training), causing decreased neonatal mortality in low-income countries where this is of major concern.[9] This study is unique in that it shows the impact education has in the long term, with measuring retention of knowledge after completing the training. Another key component of long-term retention, is the inclusion of simulations where skills can be assessed and altered in a controlled environment.[3,10-12] Here, professionals can practice and learn from mistakes all within a controlled simulation. Other

studies did not consider retention of skills due to constraints on the studies preventing assessment 6 to 12 months post-training.

In addition to BLS skills benefiting patient outcomes, the early recognition of sick patients is essential to improve patient survival. Immediate Life Support training, which emphasizes the importance of initial assessment, even including the initiation of the cardiac arrest team in-hospital due to a gut-feeling that a patient is going to progress to cardiac arrest, resulted in both a decrease in cardiac arrests and a decrease in unsuccessful resuscitation.[11] Spearpoint et al was the first study to show a significant correlation between education, behavioral change and patient-improvement with the implementation of a cost-effective training course.[11] Cost is of major concern in third world countries, so evidence that there can be beneficial patient outcomes with the implementation of a cost-effective training course is important for those areas with limited money and resources. The one difficulty with correlating this to out-of-hospital cardiac arrests and cardiac arrests in low-income countries, is that this correlation included the use of AEDs alongside basic skills.

The cornerstone of an effective educational program is based on its cost-effectiveness and ability to translate to those who will be utilizing the skills. A bordering country, Honduras, had an advanced CPR course catered to their needs in which skills were taught based on the resources the community had. This included basic CPR and airway management, however, skills like cricothyroidotomy and central lines were not taught because of the lack of training mannequins and the need for basic skills foundation.[3] Multiple sources defend the idea that altering the course to the needs of the people and stressing the importance of basic skills for everyone positively impacts patient outcomes and long-term retention of skills.

Lack of Resources:

Since Nicaragua is one of the poorest countries in the Western Hemisphere, many adequate medical resources, from ambulances to cardiac monitors to automated external defibrillators, are lacking.[13] Therefore, we must gear our efforts toward cost-effective strategies to improve medical care and patient outcomes.

Without a well-established Emergency Medical Services system in place, responsibility for recognizing, managing and addressing critical patients, such as those in sudden cardiac arrest, falls on bystanders.[4,14] This results in a need for CPR education for the layperson, as well as emphasizing the need to get the victim to definitive care at a hospital without extended pauses during compressions. Studies have shown that with high-quality CPR performed at the time of a witnessed cardiac arrest, patient outcomes at discharge increase exponentially. It is critical to cater a BLS course toward the layperson in a resource limited country to improve patient outcomes.

We can clearly see the benefits of implementing Advanced Cardiac Life Support training for medical professionals to increase likelihood of ROSC and improve patient disposition upon discharge; however, the costs of this course are not feasible in low-income countries where advanced courses are about double the cost of basic skill level courses.[4,5]

Cultural differences must also be respected when trying to implement educational training programs. Training programs must be modified to address pertinent issues in the community while also remaining cost-effective so they can be maintained.[4] Taira et al addresses the effectiveness of a resuscitation training program that has been altered to the language and

resources available in the low-income country, showing the improved patient outcomes after cardiac arrest.[12]

Methods

A broad literature search was conducted to uncover what research has been done regarding resuscitation education and patient outcomes. Search terms included CPR education Nicaragua, EMS Nicaragua, cardiac arrest Nicaragua, CPR education third world countries, and AHA CPR. Relevant article references were utilized as well as articles suggested in the right column of Pub Med's website under the "Titles with your search terms" heading. This search was further revised to include low-income and third world countries. Impacts of resuscitation education were evaluated regarding effective guidelines for regulation of CPR and patient outcomes, the educational impact of resuscitation courses and provider and layperson retention, the barrier of resources, and struggles seen within third world countries when dealing with the implementation of new standards. While reading articles, more sources were obtained from relevant references cited in these articles. Multiple papers were compiled and then grouped together based on common themes, which were then used to further investigate the question at hand. Themes and conclusions were compiled from the various sources and used to form a foundation on which interviews would be conducted while in Nicaragua.

Interviews were conducted during the stay in Nicaragua at multiple locations, including both in the rural and urban communities. All providers were asked about resources they had at their facility to handle a patient in cardiac arrest, such as a defibrillator, electrocardiogram machine, medications, and available definitive care, such as surgical interventions. Discussions ensued about what pre-hospital interventions would be performed for the patient, such as

intubation, ventilation, and compressions, and how transport occurred if the patient could not be managed at their location.

Interviews were conducted at a health care center in the 7th district on Wednesday, July 12, 2017 with Lic Alba Sandoval, Chief of Nurses, Gabriel Serrano, nurse at La Mascota Hospital, a national children's reference center, on Thursday, July 13, 2017, Dr. Leonel Argüello, epidemiologist and president of the Nicaraguan Association of General Practitioners, on Friday, July 14, 2017, and a brief discussion with Dr. Elsa Granados, physician at the community health care center in La Corona, on Monday, July 17, 2017.

Discussion

Since Nicaragua is a country without a well-developed EMS system, patients experiencing out-of-hospital cardiac arrest will have a longer duration to definitive treatment, which means patients will be more heavily reliant on bystander CPR skills. We can see this especially evident in the rural community. When meeting with Dr. Elsa Granados in La Corona where they do not have an AED or EKG, she mentioned that in an emergency they are able to stabilize the patient and call for transport. She acknowledged that they are fortunate because they have members of the community available with a vehicle in case an emergent transport is needed. In the rare situation this resource is unavailable, they can call the city of San Ramon and they send an ambulance to their location to transport the patient to the hospital for further care. This shows that patients can have an extended response time, transport time or both, so bystander CPR, with the optimal rate and depth, is essential for cardiac arrest patient survival.

In the Cheskes et al study, those patients who experience ROSC after more than 10 minutes of CPR are more likely to survive if they have received high quality, guideline

compliant CPR.[2] There is proof that an optimal compression rate and depth exists, further enforcing the need for education and training to improve survival rates among cardiac arrest patients. There can only be a broad comparison with these studies because of the lack of AED resources in the community, where hospitals in Nicaragua are lucky if they have one functional AED. Dr. Leonel Argüello stated that at their private hospital, they have one functional EKG and one AED, with money being a huge factor because one AED costs about $500; the funding is not available.

In the United States, emergency or critical care providers are very highly trained and qualified, all having both Basic Life Support certification as well as Advanced Cardiac Life Support, allowing them to confidently handle a patient in cardiac arrest. This is not the same globally, especially when working with low-income countries. We must inquire where the holes in education lie to best assist the community. Spivak reported that in Guatemala, providers were highly trained when it came to diagnosing and treating a myocardial infarction; however, they lacked the basic skills and foundation of CPR.[15] This study explained how some firefighters even believed resuscitation to be effective by pumping the arrested patient's legs.[15] When visiting the private hospital Friday, July 14, 2017, we were given a tour of their facility by one of the nurses who was able to address how they are working to keep their health care providers educated and versed in CPR. Their facility received an Annie CPR Training mannequin as a donation from a Spanish organization where a respiratory technician came in and trained their staff in CPR and intubation procedures (See Appendix A). There are three ways now in which their facility is further educating others in these techniques: the staff is initially trained, the community is trained through clubs that have formed, and then their staff travels to the ministry of health clinics in

Nicaragua to train staff members at various locations. Staff at the ministry of health locations can continue to further educate the community on these techniques and procedures.

Evidence shows a lack of primary assessment skills in developing countries, thus there needs to be an emphasis on basic, initial recognition of sick patients and those who need to be critically managed to avoid or at least prepare for imminent cardiac arrest.[4,11] The way to effectively manage this issue is to educate the community and provide basic life support skills. In developing countries, and in general, cardiac arrests are very common to occur out-of-hospital, which puts a lot of dependence on the community to know how to manage such a situation. Lic Alba Sandoval, chief of nurses at a health care center in the 7th district addressed how their community is acknowledging the lack of bystander CPR education. Currently, they have BLS training courses for the community and they have been able to see the positive impact educating bystanders in CPR is having on patient outcomes; however, they do not have enough time or resources to keep up with the training demand. To effectively educate their community, she said they would need to have 4-hour sessions several times a week, because right now there is a new group at every training session, so consistency and testing skills retention is not possible. As a temporary fix to assist with the lack of resources, they are now providing a handout to take home for those who have completed the training (See Appendix B). This provides a reference for the layperson to consult in an emergency. The major difference noted is the layperson is taught a compression to ventilation ratio of 5-to-2, while the health care provider is taught 30-to-2, which is also the ratio taught by AHA guidelines in the United States.

There are many health care needs in Nicaragua, but with cardiovascular and circulatory disease remaining at the top of the list for death in the country, CPR education needs to remain a priority and extend to educating the community. Key components of improved survival post-

cardiac arrest, especially OHCA, are early recognition and initiation of bystander CPR. In one resuscitation training program utilizing pre-and post-training test scores, Meaney et al found the highest procurement and retention of knowledge and skills to be in the group of participants with the lowest pre-test scores.[4] This supports the benefit of educating the layperson on BLS skills, so they can recognize and manage out-of-hospital cardiac arrest until a higher level of care can be reached.

Conclusion

The compilation of these studies and anecdotal support gathered while in Nicaragua supports the impact education on high-quality CPR among the community can have on out-of-hospital cardiac arrest patient outcomes. Even though some studies showed guideline-compliant CPR does not improve all patient outcomes, we cannot estimate the time it will take a patient to achieve ROSC. Therefore, educating the public and refining the skills of health care professionals can have a significant positive impact on out-of-hospital cardiac arrest patient outcomes if there is definitive treatment available. This is where most of the difficulty arose in Nicaragua, because definitive treatment, like an AED, are present but scarce, and the use of surgical intervention was not even addressed for patients in cardiac arrest. Although clinics rarely have an AED available, hospitals usually have at least one functional defibrillator and Red Cross Fire Departments carry an AED on their emergency vehicles. This definitive treatment must be accessible for bystander CPR to increase survivors of OHCA.

There is also clear evidence in retention of education, even for those with limited academic backgrounds. This shows that education and training programs need to be implemented for the whole community, not just health care professionals. These training programs are being implemented, and health care professionals like Lic Alba Sandoval, attest to the positive impact

it is having on patient outcomes post-cardiac arrest. Not only are communities working to train the layperson in CPR and basic life support, but according to Dr. Leonel Argüello, they are working with the ministry of health towards creating standards for health care professionals so that CPR is a required part of their training.

For these training programs to be well received by the community and continuously implemented, there needs to be open and honest communication to uncover the needs of the country. A formal training program can then be catered to their needs and resources, resulting in improved patient outcomes. We can see how this has already begun in some of the communities. The government has provided a handout so that members of the community can reference basic emergency skills so they are able to act and assist those in need if a difficult situation were to arise (Appendix B). The 7th district hands out these pamphlets to the members of the community who have taken their CPR and first aid course, and here we see that the document has altered the compression to ventilation ratio for the layperson to be different than what AHA recommends. Although the explanation behind this different ratio was not provided, it was evident that they purposely changed the ratio from AHA guidelines. This could be due to the stamina needed to keep up with a 30:2 ratio, or a potential learning curve they have run into with the implementation of their bystander CPR training classes. Patient outcomes using the 5:2 ratio will need to be studied to further evaluate the effectiveness of this adaptation. Dr. Leonel Argüello and their private clinic, which is also a teaching hospital, is taking it upon their staff to be well-versed in CPR and the AHA guidelines so they can train the community and other health care professionals working at clinics. This way, they are volunteering their time and cutting costs to create an affordable and effective training model.

Definitive care must be present if these educational efforts are going to have an impact on cardiac arrest patient outcomes. Training programs have been initiated with positive patient outcomes in some areas of Nicaragua, which is in part due to the availability of resources, like an AED, at hospitals in the community. For CPR education to continue to have a positive impact on patient outcomes, training needs to be mandated for health care professionals, a standardized course needs to be taught with ongoing assessment of skills, and adequate definitive care (AED, surgery) needs to be readily available. With cardiovascular and circulatory disease remaining one of the top causes of death, the health care community is actively working towards improving the community's education and access to resources for definitive care.

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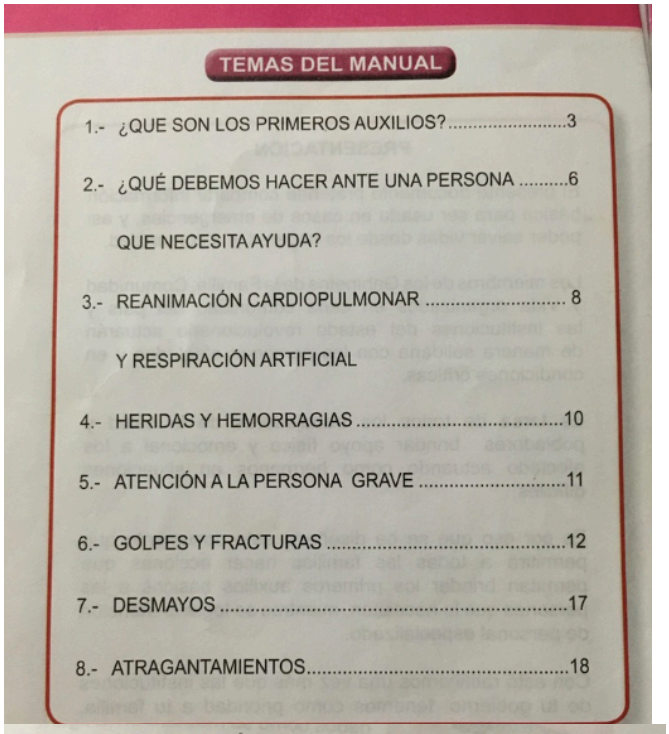
Appendices

Appendix A: Rescue Annie CPR Training mannequin provided to the private hospital by a Spanish organization as a resource to use while training the community and health care providers on CPR

Appendix B: Handout provided by Lic Alba Sandoval at the health care facility, 7th district, which is used as a resource for those who have completed CPR training



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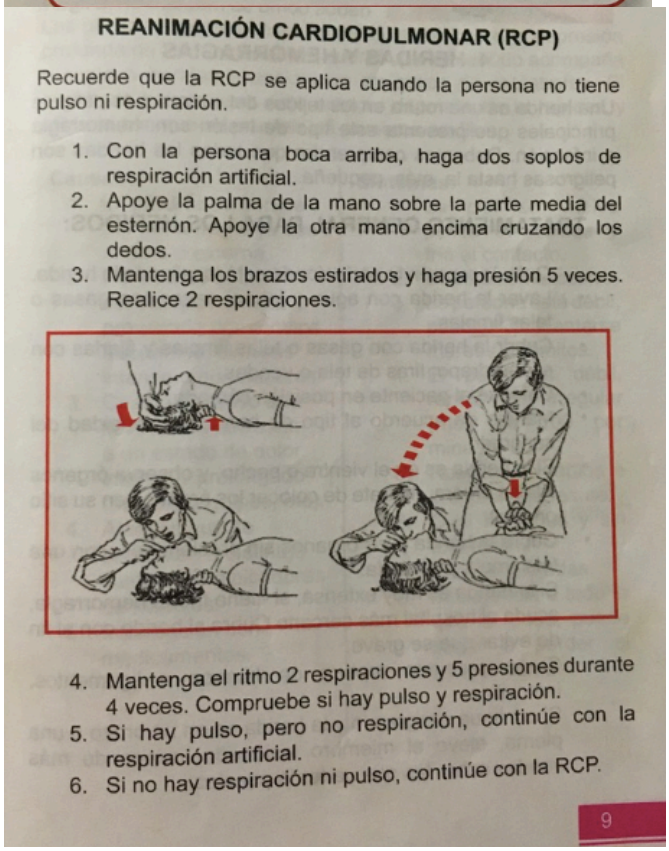

REANIMACIÓN CARDIOPULMONAR (RCP)

Recuerde que la RCP se aplica cuando la persona no tiene pulso ni respiración.

1. Con la persona boca arriba, haga dos soplos de respiración artificial.
2. Apoye la palma de la mano sobre la parte media del esternón. Apoye la otra mano encima cruzando los dedos.
3. Mantenga los brazos estirados y haga presión 5 veces. Realice 2 respiraciones.

4. Mantenga el ritmo 2 respiraciones y 5 presiones durante 4 veces. Compruebe si hay pulso y respiración.
5. Si hay pulso, pero no respiración, continúe con la respiración artificial.
6. Si no hay respiración ni pulso, continúe con la RCP.

9

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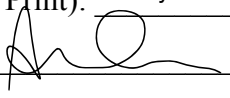
Author's Signature:  Date: 08/27/2018

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